



HP ProLiant G6 Technology Overview

(featuring servers based on the Intel® Xeon® processor 5500 series)



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Introducing the HP ProLiant G6 servers

The sixth-generation (G6) of HP ProLiant DL, ML, and BL servers is the broadest range of servers in the industry based on the Intel® Xeon® processor 5500 series. The ProLiant G6 server lineup includes rack, tower, and server blades that provide industry-leading energy efficiency, extreme flexibility, and scalable performance. HP has also developed smart management tools that help you squeeze every bit of productivity out of each ProLiant G6 server and get the best return for your budget.

Spend less for power and have more for your business

ProLiant G6 servers deliver up to 2.5 times more power efficiency, compared to the previous generation of servers, through the use of Thermal Logic technology. Originally limited to the HP BladeSystem, Thermal Logic technology is now implemented across the ProLiant G6 server portfolio and includes Dynamic Power Capping, a 'Sea of Sensors', and common power slots.

Triple the power capacity of your existing data center

Dynamic Power Capping can help you reclaim power capacity hidden by overly conservative power allocation based on footprint ratings. Reclaimed power capacity can triple your compute capability and extend the life of your data center up to 50%.

Continuously optimize server efficiency

A 'Sea of Sensors' monitors the internal environment of each ProLiant G6 server and intelligently manages power to major components in real-time, preventing over-heating or over-cooling, thereby optimizing efficiency.

Maximize energy savings and reduce spares with common power slots

Many ProLiant G6 servers have common power slots, which allow them to share a range of highly efficient power supplies. The common power slots allow you to right-size the power supply for each server to maximize power efficiency, and it decreases the number of spares in inventory.

Unite physical and virtual environments to maximize productivity

HP infrastructure and management tools can help you squeeze every bit of productivity out of ProLiant G6 servers. By uniting your physical and virtual server environments, these tools simplify setup and operations, reduce operating expenses, and decrease virtualization complexity.

Reduce operating expenses

The HP Insight Control suite and HP Insight Control suite for Linux include a complete set of lifecycle management tools that help you save time and money. Originally bundled only with HP BladeSystem enclosures, the Insight Control suite (ICE) is now available in select ProLiant G6 DL server models.

Simplify setup and operations

Every ProLiant G6 server includes the HP Onboard Administrator, which delivers simplified server setup, dynamic power and thermal control, embedded server health monitoring, and lights-out remote administration for individual servers from any location.

Decrease virtualization complexity

- HP Insight Server Migration software for ProLiant automates the migration process by moving your existing physical or virtual servers to the latest ProLiant G6 servers or to other virtualization platforms.
- HP Insight Dynamics-VSE provides advanced management for the HP BladeSystem. Using logical servers, HP Insight Dynamics-VSE brings server blades and virtual machines together under a single management paradigm. It is the world's first integrated solution that lets you visualize, plan, and change physical and virtual resources in the same way.

- HP Virtual Connect Flex-10 technology is available on all ProLiant 400 and 600 series G6 server blades. It is the world's first technology that allows you to divide and fine-tune 10Gb Ethernet network bandwidth to match virtual server demands. It provides four times more network ports per server blade, cutting network connection costs by up to 75% per virtual server.

Make every server purchase count

ProLiant G6 servers offer more memory, processing, and I/O to support more users, transactions or virtual machines than ever before.

Get more done with half the servers

HP offers the industry's broadest line-up of Intel-based platforms that utilize the new Intel Xeon 5500 series processors. The Intel Xeon 5500 series processors give you a tremendous step forward in technology and the new ProLiant G6 servers take full advantage of these advancements delivering double the performance of existing quad-core servers. New DDR-3 memory technology offers twice the bandwidth and double the capacity, while using 25% less power. ProLiant G6 servers include the new generation of HP Smart Array Modular Controllers delivering 200% greater performance

Quickly resolve problems with Insight Remote Support

HP and its authorized channel partners are by your side with HP Insight Remote Support all day, every day. You can have your systems remotely monitored for hardware failure 24x7 using secure technology that's been proven at thousands of companies around the world. In many cases, you can avoid problems before they occur – reduce downtime, cut support costs and make better use of your resources.

Customize service with Proactive Select

HP Proactive Select allows you to build the exact service plan you need—no more, no less—with a flexible service access program based on a simple credit point system. This new service is similar to a pre-paid card where customers can buy service credits. They save time with a single approval and procurement cycle for multiple services delivered over a period of up to five years with an option to add credits or change services. This includes data center services, mission critical facilities, and education. This flexible service access program allows you to tap into over 85 different service offerings so that you can more easily take advantage of the broad portfolio of HP Technical Services.

Technologies in ProLiant G6 servers

Intel® Xeon® processor 5500 series

Dual-processor ProLiant G6 servers feature Intel Xeon 5500 series quad-core processors based on the Intel® Microarchitecture, codenamed Nehalem. Xeon 5500 series processors are packed with new and enhanced technologies, such as on integrated memory controller, a three-level cache hierarchy, Intel® Hyper-Threading Technology, Intel® Turbo Boost Technology, and Dynamic Power Management. Through the modular processor design, these technologies become building blocks to construct a range of cost and performance options for ProLiant G6 servers. The new Intel® QuickPath Technology maximizes data transfer between the processors and other system components.

Intel QuickPath Technology

QuickPath Technology unleashes the performance of the new processor microarchitecture. It replaces the shared front-side bus and memory controller hub found in previous-generation architectures with high-speed, point-to-point interconnects directly linked to the processors and I/O chipset. Each Intel® QuickPath Interconnect (QPI) consists of two uni-directional links that operate simultaneously in each direction. Unlike a typical serial bus, each QPI transmits data packets in parallel across multiple lanes. Initially, each QPI has a total bandwidth up to 25.6 GB/s.

Integrated memory controller

One of the most notable improvements in Intel Xeon 5500 series processors is the integrated memory controller. The memory controller uses three channels (up to 1333-MHz each) to access dedicated DDR-3 memory sockets. This delivers a big performance improvement over previous architectures that provide only two memory channels and require processors to share a single pool of system memory. The three memory channels have a total bandwidth of 32 GB/s.

Three-level cache hierarchy

Each Intel Xeon 5500 series processor has a three-level cache hierarchy that consists of an on-core 64-KB L1 cache, a separate 256-KB L2 cache for each core, and a new inclusive, shared L3 cache of up to 8 MB. The L3 cache duplicates the data stored in the L1 and L2 caches of each core. This data duplication eliminates unnecessary searches, or snoops, to those caches and minimizes latency. Additional data tracking technology in the L3 cache ensures inter-core cache coherency. If one processor needs to access the cache or DDR-3 memory of the other processor, it uses the high-speed GPI between the two processors.

Intel Hyper-Threading Technology

Hyper-Threading (HT) Technology enables each core to execute two computational threads at the same time, thus, allowing each quad-core processor to simultaneously execute up to eight threads. As a result, HT Technology improves performance per watt by allowing ProLiant G6 servers to do more using the same or less power than the previous generation of ProLiant servers.

Intel Turbo Boost Technology

Turbo Boost gives an administrator the option to manually or automatically turn off individual cores and run the remaining cores faster than their nominal frequency, if there is power and thermal headroom to do so. The administrator can determine the headroom using criteria such as the desired number of active cores, estimated power use, and maximum processor temperature.

Dynamic Power Management

Dynamic Power Management works hand-in-hand with Turbo Boost to automatically optimize the performance and power use of the processor, chipset, and memory based on business requirements. In essence, Dynamic Power Management allows Intel Xeon 5500 series processors to provide greater performance using the same amount of power as previous generation Intel processors. Or, it allows them to achieve performance equivalent to previous generation processors using less power.

DDR-3 memory technology

ProLiant G6 servers based on the Intel Xeon 5500 series processor support DDR-3 memory technology—DDR3-800, DDR3-1066, or DDR3-1333. DDR-3 dual in-line memory modules (DIMMs) provide the same reliability, availability, and serviceability as DDR-2 DIMMs; however, DDR3 DIMMs use less power, have lower latency, and deliver higher bandwidth. DDR-3 DIMMs operate at 1.5V, compared to 1.8V for DDR-2 DIMMs. This translates into more than 25% in power savings comparing the fastest DDR-2 DIMM (DDR2-800) to the slowest DDR-3 DIMM (DDR3-800). The power savings increase to almost 35% comparing the most commonly used DIMMs, DDR2-667 and DDR3-1066.

It's important to note that there are two types of DDR-3 DIMMs—registered (RDIMMs) and unbuffered (UDIMMs)—and they cannot be used together in a system. ProLiant G6 servers support up to three RDIMMs per channel or up to two UDIMMs per channel. RDIMMs have larger capacity (up to 8 GB each) than UDIMMs (up to 2 GB each). Higher-end ProLiant G6 servers support up to 18 sockets. In these servers, RDIMMs enable total memory capacity of up to 144 GB, compared to 24 GB for UDIMMs. This makes RDIMMs the ideal choice for virtualization, while UDIMMs provide cost and power savings for less memory-intensive applications.

The memory channels can operate at up to 1333 MHz, but the actual speed depends on the number and type of DIMMs populating the slots. For example, in a fully-populated system using DDR3-1333

DIMMs, the memory bus speed drops to 800 MHz to maintain signal integrity. Therefore, the type of workload dictates the optimum number and type of DIMMs to use. Memory capacity may be of primary importance in virtualization environments, while memory channel speed may be more critical for high performance computing applications.

Because there are several memory options, HP simplifies memory selection by providing two helpful resources. First, the on-line ProLiant Memory Configuration Tool (www.hp.com/go/ddr3memory-configurator) will walk you through the steps to configure your server's memory and provide an orderable parts list. Second, the *DDR-3 Memory for Dummies* booklet provides information and tips about populating the system memory of ProLiant G6 servers.

Smart Array technology

Smart Array controllers

The latest Smart Array controllers, introduced in January 2009, are capable of boosting the I/O performance of ProLiant G6 servers up to 200% over the previous generation of servers. The new modular design is the industry's first to scale from entry RAID solutions for small and medium businesses, to high end RAID functionality for larger enterprises, all through the simple addition of hardware and software expansion options. The latest Smart Array controllers have 3Gb SATA capability. Some ProLiant G6 servers support 6Gb SAS today, and the remaining G6 servers will support 6Gb SAS when a firmware upgrade becomes available in mid-2009. Other Smart Array controller features include SATA native command queuing, improved battery life, and the HP Smart Array Advanced Pack.

SATA native command queuing

SATA native command queuing (NCQ) enables 3.0-Gb/s SATA hard drives to queue and rearrange the order of multiple data requests to maximize throughput without any assistance from the CPU. NCQ is available across the entire line of the latest Smart Array controllers.

Improved battery life

The battery life for battery-backed write cache has been improved so that a single battery can last up to two days. Previously, two days of battery life required two batteries.

HP Smart Array Advanced Pack

The Smart Array Advanced Pack (SAAP) provides additional and enhanced features that can be initiated on-demand with a software key from HP. Release 1 of SAAP includes several features:

- RAID 6 – protects against the simultaneous failure of two drives in an array without downtime or data loss
- RAID 60 – provides enhanced protection for JBODs (just a bunch of disks)
- Advanced Capacity Expansion (ACE) – allows you to transfer the contents of a disk array to a second set of physical drives in order to upgrade the capacity or speed of the drives. ACE also allows you to shrink the size of the array (remove excess drives) after its capacity has been expanded.
- Secure Drive Erase – securely erases the contents of hard drives or logical units without running a "shredder" utility on the host computer

HP SAS Expander Card

If you need to create or expand a RAID array across more than eight internal drives, the HP SAS Expander Card is ideal. It allows you to expand or create a RAID array of up to three drive cages, each containing eight drive bays. Without the HP SAS Expander Card, each drive cage requires a separate Smart Array controller, and each controller can drive a single RAID array of eight drives. The HP SAS Expander Card attaches to a Smart Array P410 or P410i (internal) controller through two mini SAS ports. It also has a mini SAS 4x (external) port to connect to a SAS tape device.

Thermal Logic technologies

HP is extending Thermal Logic technologies—originally offered on the HP BladeSystem—to all ProLiant ML, DL, and BL G6 servers. Thermal Logic technologies include Dynamic Power Capping, thermal sensors, and common slot power supplies. Together, these technologies double the power efficiency of ProLiant G6 servers compared to the previous generation of servers.

Dynamic Power Capping

Typically, processors are responsible for about one-third of the power consumed by a server, and indirectly drive the power use and heat generated by other server components. By controlling the processor's power use, you can control power use of the entire system. Dynamic Power Capping takes advantage of this processor-driven model and controls overall server power consumption using two separate mechanisms: changing the processor performance state (P-state) and throttling the processor clock.

Dynamic Power Capping allows an administrator to set a maximum power consumption level for one or more ProLiant G6 servers. Then it monitors each server and uses P-states and/or clock throttling to limit processor power use and control overall system power use. If a server exceeds the power use cap set by the administrator, Dynamic Power Capping lowers the server's power use in a controlled manner, regardless of changes in the server workload or environment. If a server experiences a sudden increase in workload, Dynamic Power Capping can bring it back under its power cap in less than half a second, preventing any surge in power demand that could trip a typical data center circuit breaker.¹ This allows an administrator to electrically provision a power distribution unit (PDU) or a rack to something less than the combined faceplate power rating of all the servers in the rack.

The first step in power capping is to measure the server's power use with Systems Insight Manager or Insight Power Manager; however, only Insight Power Manager monitors server power over time. Administrators can then set individual power caps for servers using HP iLO Advanced or Insight Power Manager (IPM). Using IPM, administrators can also set power caps for groups of ProLiant ML and DL servers and for groups of BladeSystem enclosures. To set a power cap for an individual enclosure, the administrator can use the BladeSystem Onboard Administrator or IPM.

To control the power use of a group of servers, IPM separately sums the minimum power use, the maximum power use, and power supply ratings of servers in the group. It then displays these three totals in a graphic user interface. The interface allows the administrator to apply a group power cap that is between the total minimum power use and the total power supply rating. Then IPM assigns each server a proportion of the total power. These individual power caps will remain in place until an administrator changes them through the HP iLO Advanced or IPM interfaces.

It gets even better for the HP BladeSystem. Enclosure Dynamic Power Capping is a special implementation of Dynamic Power Capping designed specifically for HP BladeSystem enclosures. Enclosure Dynamic Power Capping monitors the workloads of the individual server blades and then reapportion the individual power caps of the servers after a predetermined monitoring cycle. This allows the busiest server blades to draw more of the total enclosure power.

'Sea of Sensors'

In each ProLiant G6 server, up to 32 sensors monitor the internal server environment and make real-time adjustments to optimize power use. For example, the sensors can save power by adjusting fan speeds to prevent overcooling, and they can reduce power to unused I/O and memory sockets.

Common Slot Power Supplies

Many ProLiant G6 servers have common power slots that accommodate a range of power supplies. This new generation of universal, hot-pluggable power supplies reduces the number of spares and

¹ Dynamic Power Capping has been designed and tested to ensure that it can prevent tripping circuit breakers that have a specified trip time of three seconds or longer at 50 degrees C and 150 percent overload.

lowers power use by allowing you to right-size the power supply for the server configuration. There are three common slot AC power supplies: 460 watt, 750 watt and 1200 watt. The AC power supplies work with input voltages from 100 to 240 volts, making them usable worldwide. These power supplies provide up to 92% efficiency, which meets Climate Savers Gold qualifications. The new HP Power Advisor calculator removes the guesswork in selecting the right power supply for each server's configuration.

Infrastructure management technologies

HP Insight Control suite

HP Insight Control suite (ICE) offers a set of capabilities that simplify server management through the entire lifecycle of ProLiant 300 series and above G6 servers and ProLiant G6 server blades. ICE, which is based on HP Systems Insight Manager, provides comprehensive system health, remote control, vulnerability scanning, patch management, flexible deployment, virtual machine management, and power management. ICE components deliver lifecycle management functions through a single installer and a simplified licensing mechanism.

Within ICE, the Virtual Machine Management capability provides central management and control of VMware ESX Server, Microsoft Windows 2008 Server Hyper-V, and Citrix XenServer virtualized environments. Features include:

- showing physical host to virtual machine associations
- easy identification of virtual machines (VMs) or host servers reaching high CPU, memory, or disk utilization levels
- highly flexible move capabilities
- moves to dissimilar host resources
- back up, template, and alternate host capabilities that enable restoration of VMs on any available host

HP Insight Control suite for Linux

HP Insight Control suite for Linux (ICE-LX) is an integrated solution to manage multi-system Linux environments. This integrated suite provides productivity for Linux administrators in both enterprise and cluster environments. HP ICE-LX integrates a robust feature set of the best of open source and HP technologies for discovery, imaging and provisioning, deployment, firmware updates, monitoring, remote access, virtualization, and general lifecycle management. Open source software, such as Nagios® and XenServer™, are fully integrated and auto-configured for immediate user productivity. Full lifecycle management is complemented by multi-system scaling, thermal and power management, and direct-to-hardware control.

Onboard Administrator

HP Onboard Administrator, which is included at no additional charge with every ProLiant G6 server, is like having a programmable administrator inside each server. On HP ProLiant 100 series G6 servers, ProLiant Onboard Administrator Powered by iLO100 works hand-in-hand with HP Systems Insight Manager, RBSU, ORCA, and the embedded Baseboard Management Controller (BMC) to provide entry-level remote management and control. On ProLiant 300 series G6 servers and ProLiant G6 server blades, Onboard Administrator Powered by iLO works hand-in-hand with HP Systems Insight Manager, Insight Control, and Insight Dynamics, helping customers unlock the value of the ProLiant platform and delivering the highest possible quality of IT service to the business. It is accessible through a web browser to give you control over four aspects of each server:

- **Simplified server setup** – Consistently configure server boot order, network configuration, RAID settings, and other server parameters. Use these control surfaces with your own internally developed deployment scripts or with Insight Control suite, which can help decrease deployment times by as much as 65% compared to manual deployment methods.

- **Extended embedded health** – Use ProLiant Onboard Administrator's embedded health monitoring to determine the status of important server components, regardless of whether the OS is running or offline.
- **Power and thermal control** – Use power and thermal controls embedded into ProLiant Onboard Administrator to reduce server power consumption by regulating processor clock speed and by providing an optional high-efficiency mode for power supplies. Use Dynamic Power Capping with HP Insight Control suite to extend the life of your data center by reclaiming power and cooling capacity hidden by overly conservative policies based on face plate ratings.
- **Lights-Out remote administration** – Use Integrated Remote Console to save time and money by interacting directly with the server OS or pre-OS environment without leaving your desk. Use Virtual Media, including Virtual Folders, to deliver emergency updates of remote servers. Take advantage of the multi-user console and video record and playback to more effectively collaborate with IT staff across multiple locations.²

Virtualization technologies

HP Insight Dynamics-VSE

HP ID-VSE is the first integrated solution that lets you analyze and optimize physical and virtual resources in the same way. It makes the infrastructure adaptive, with the freedom and flexibility of virtualization delivered across the physical infrastructure. With advanced planning and visualization, it makes the following types of change more predictable and easier to manage:

- Continuously consolidating the computing infrastructure
- Building a more dynamic test and development infrastructure
- Providing fast and affordable high availability where it was not cost-effective before
- Performing energy-aware capacity planning

HP ID-VSE includes HP Insight Control suite and HP Systems Insight Manager. Virtual Connect and Virtual Connect Enterprise Manager must be purchased separately. As part of the HP Insight software family, all of these tools work together in a fully integrated fashion.

HP ID-VSE includes three key capabilities: the logical server, capacity planning, and unified control of physical and virtual infrastructure. The Insight Orchestration option for Insight Dynamics-VSE adds the ability to do self-service operating system deployment.

Virtual Connect Flex-10 technology

Virtual Connect Flex-10 is a hardware-based solution that allows you to obtain maximum virtual machine (VM) density through finer control of 10 gigabit Ethernet (10GbE) networking bandwidth. As you add VMs to a single physical ProLiant server blade, Flex-10 allows you to partition each 10GbE network connection and regulate the speed of each partition based on the performance requirements of each VM. Manage it all more easily with Virtual Connect Enterprise Manager which lets system administrators add, replace, and recover servers across the data center in minutes without impacting LAN and SAN availability.

This flexible change-ready infrastructure also lays the foundation for the logical server management and other capabilities delivered with HP Insight Dynamics-VSE and HP Insight Orchestration software.

Flex-10 technology enables Virtual Connect to configure a single 10Gb network port of a server blade to represent four physical network interface controller (NIC) devices (also called FlexNICs) with a total bandwidth of 10 Gb/s. These four FlexNICs appear to the operating system (OS) as discrete NICs, each with its own driver. Each dual-port Flex-10 device supports up to eight FlexNICs, four on each physical port. Each Flex-10 Interconnect Module can support up to 64 FlexNICs. Using the

² Advanced remote control functionality requires an iLO Advanced license for ProLiant ML/DL servers and an iLO Advanced for Blade System license for ProLiant BL servers.

Virtual Connect interface, you can adjust the bandwidth available to each FlexNIC from 100Mb to 10Gb in 100Mb increments.

The advantages of using Flex-10 technology are significant. The 10GbE infrastructure becomes more cost efficient and easier to manage because Flex-10 allows you to fully utilize the 10-Gb bandwidth. The fact that Flex-10 is hardware based means that multiple FlexNICs are added without the additional processor overhead or latency associated with server virtualization. Flex-10 also reduces infrastructure costs by eliminating the need for some server NIC mezzanine cards and interconnect modules.

HP Insight Server Migration software for ProLiant

HP Insight Server Migration software for ProLiant automates the process of migrating your existing physical or virtual server to the latest ProLiant G6 servers or to the latest virtualization platforms from VMware, Microsoft, and Citrix. Without Insight Server Migration software, you need to manually install the drivers, OS, and applications, and transfer the data to the new server.

When administrators try to use an off-the-shelf image capture product, they often find that the migration process is filled with errors, requiring several man-hours to troubleshoot. Insight Server Migration software eases the migration process by allowing you to simply identify the source, identify the target, and click "GO." Insight Server Migration software transfers the OS, applications, and data without any errors; it even installs the correct drivers required for the destination server. This automated process can take one-fourth the time of a manual migration.

Remarkably, Insight Server Migration software supports four types of server migrations: physical-to-physical, physical-to-virtual, virtual-to-physical, and virtual-to-virtual. For physical-to-physical server migrations, the source server can be any vendor's x86 server. For virtual-to-virtual migrations, Insight Server Migration software can migrate between the different virtualization platforms mentioned previously.

Insight Server Migration software requires three components for any migration: the source server, destination server, and an application station. The application station is the central execution point for all migrations. Unless the application station is running HP System Insight Manager, it can be a workstation or notebook PC.

For more information

For additional information, refer to the resources listed below.

Resource description	Web address
HP ISS Technology Papers	http://h18004.www1.hp.com/products/servers/technology/wHITEpapers/index.html?jumpid=servers/technology
HP ProLiant servers home page	www.hp.com/servers/proliant

Call to action

Send comments about this paper to Krista.Satterthwaite@hp.com.

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